PENNSYLVANIA RAILROAD, ALLEGHENY TUNNEL
Pennsylvania Historic Railroad Bridges Recording Project
Beneath Allegheny Mountain, east of Railroad St.
Gallitzin
Cambria County
Pennsylvania

HAER No. PA-515

HAER
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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
1849 C Street, NW
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HISTORIC AMERICAN ENGINEERING RECORD

PENNSYLVANIA RAILROAD, ALLEGHENY TUNNEL

HAER No. PA-515

Location:	Beneath Allegheny Mountain, east of Railroad St., between Gallitzin, Cambria County, and Duncansville vicinity, Blair County, Pennsylvania.
USGS Quadrangle:	Cresson, Pennsylvania (7.5-minute series).
UTM Coordinates:	17/707605/4483870 (west portal) 17/708690/4483640 (east portal)
Dates of Construction:	1851-54.
Basis for Dating:	Plaque on tunnel.
Designers:	Edward Miller, Herman Haupt, Chief Engineers; Thomas Reilly, Engineer; Thomas Seabrook, Principal Assistant Engineer.
Builder:	John Rutter & Son, Contractors.
Present Owner:	Norfolk Southern Railroad.
Present Use:	Railroad tunnel.
Structure Type:	Stone lining; brick lining.
Significance:	Allegheny Tunnel is an example of a mid-nineteenth century railroad tunnel featuring ashlar masonry portals and a brick arch lining. Upon completion it was the longest railroad tunnel in America, allowing railcars to pass for the first time from Philadelphia to Pittsburgh without the use of inclined planes. As an integral part of the development of the Pennsylvania Railroad, it is associated with significant development in the transportation history of America. Herman Haupt made significant contributions to the fields of railroad, tunnel and bridge engineering.
Historian:	Richard M. Casella, August 1993.
Project Information:	Allegheny Tunnel was recorded in August 1993 by the Cultural Resource Group of Louis Berger & Associates, Inc., East Orange,

New Jersey, for Consolidated Rail Corporation (Conrail), Philadelphia, Pennsylvania. The recordation was undertaken pursuant to a Memorandum of Agreement between Conrail and the Pennsylvania Historical and Museum Commission in association with Conrail's program to increase vertical clearances on its lines across Pennsylvania. Project personnel included Richard Casella, Architectural Historian, Ingrid Wuebber, Historian, and Bruce Harms, Photographer.

This report was transmitted to the Library of Congress as part of the Pennsylvania Historic Railroad Bridges Recording Project, conducted by the Historic American Engineering Record (HAER) during 1999 and 2000, under the direction of Eric N. DeLony, Chief. The project was supported by the Consolidated Rail Corporation (Conrail) and a grant from the Pennsylvania Historical and Museum Commission (PHMC). Jet Lowe, HAER photographer, produced large-format photographs.

DESCRIPTION

Allegheny Tunnel connects two townships and two counties in Pennsylvania. The west portal is located in the Township of Gallitzin in Cambria County and the east portal is located in the Township of Allegheny in Blair County. The tunnel presently serves the westbound track of Conrail's main line over the Allegheny Mountains.

The Allegheny Tunnel is 3,612' long, 21'-7" wide and 19'-5" high with dressed ashlar masonry portals and bench walls, and a brick lining. The Allegheny Tunnel is connected with the adjacent and parallel Gallitzin Tunnel by continuous portal facewalls and by an internal connecting tunnel. The Allegheny Tunnel is located approximately 50' south of the Gallitzin Tunnel. The east and west portal arches are identical, both being horseshoe arches of cut sandstone. The voussoirs measure approximately 12" wide on the intrados, 14" wide on the extrados, 16" in height, and either 2' or 4' in depth. The joints are mortared but extremely tightly fitted. The end faces of the portal voussoirs are tooled with pecked faces, surrounded by a sawn border and chamfered edges.

The tunnel is lined at each end for a distance of 50' with smooth-faced, coursed-ashlar sandstone. Beginning 50' in from each end, the tunnel is completely lined with a semi-circular, five layer brick rowlock arch. The brick lining springs from a continuous quarry-faced, coursed-ashlar benchwall, 8'-9" in height. The benchwall is battered approximately 2" to the foot which results in the tunnel's horseshoe shape. A portion of the brick lining near the center extends from the quarter-point to quarter-point rather than the springline. Much of the crown of the tunnel has been covered with layers of Gunite or shotcrete, applied at various times for the purpose of repointing the mortar joints. Centered on the crown of the arch, 20' in from each end, is a rectangular opening and short vertical shaft, approximately 3' x 4'. This shaft, known as a pigeon-hole, is constructed with smooth-faced, coursed-ashlar sandstone. Its purpose was to allow the masons to finish placing the keystones of the arch and back themselves out of the space between the arch and the timbering. A "pass-through" tunnel connects the adjacent Gallitzin Tunnel 1,400' in from the east end. The arched pass-through is brick lined, approximately 12' in height and width. A brick wall and rectangular door opening enclose the arch at the Allegheny tunnel side.

The portal facewalls are approximately 25' high, constructed of quarry-faced, coursed-ashlar sandstone, 16"-18" thick and varying in length from 1' to 4'. The facewall extends above the opening approximately 5' and is capped with cut smooth-faced sandstone blocks, 18" thick and 6' long with a 4" overhang. The west portal facewall extends to the south approximately 5' to meet the steep rock embankment, and to the north 20' to abut the facewall of the Gallitzin Tunnel. A plaque is centered over the keystone just under the coping at the west portal and reads:

SECTION No 105
ALLEGHENY TUNNEL-PENN RAIL Rd
JOHN RUTTER & SON CONTRACTORS
J. EDGAR THOMPSON, PRESIDENT COMMENCED
E. MILLER & H. HAUPT, CHIEF ENGRS. OCT 14, 1851
THOMAS SEABROOK P A ENGINEER FINISHED
THOMAS REILLY ENGINEER

The east portal facewall construction is identical to the west end described above. A concrete retaining wall abuts the facewall, 4' south of the opening. The retaining wall is approximately 12' in height, extending out from the facewall and paralleling the track for a distance of 150'. A concrete foundation, originally supporting the tunnel ventilation fan, is built into the retaining wall and extends out approximately 16' to within 8' of the tracks. A set of concrete stairs rises along the east side of the foundation to the top of the foundation footing. A single track is centered in the tunnel and the roadbed elevated approximately 1' to allow drainage along the base of the bench walls.

HISTORICAL INFORMATION

General Background

The origins of the Allegheny Tunnel and the Pennsylvania Railroad, as with many roads in America, can be traced to the earliest transportation routes forged by Native Americans. The route for the railroad around and over the Allegheny Mountain, followed portions of a twenty-three mile long Indian path known as the Kittanning Path. The path, which ran east-west across Cambria County connecting the Juniata and Allegheny Rivers, "followed as level a route as could be found" (Gooderham 1954, n.p.). The path avoided the greatest peaks of Laurel Hill and Chestnut Ridge Mountains by sweeping to the north, and avoided Allegheny Mountain with a route that would later be the location of the famous Horseshoe Curve on the Pennsylvania Railroad. The Kittanning Path was one of the most important arteries of commerce in Pennsylvania in the early eighteenth century, and is credited with the development of the western part of the state, and the opening of the Ohio Valley to settlement (Gooderham 1954:n.p.).

At the beginning of the nineteenth century, the cost to transport goods by wagon across the primitive roads and turnpikes of Pennsylvania between Philadelphia and Pittsburgh cost $120 to $220 per ton. The opening of the Erie Canal in 1825 offered transportation at a fraction of that cost and created a rivalry between northeastern seaport cities vying for the trade of the Great Lakes and Ohio Valley (Fitzsimons 1990:101).

Facing ruin, Philadelphia merchants and the iron industry from southwestern Pennsylvania, lobbied the legislature to build a state-owned transportation system to open the interior of the state and access western markets. Ground was broken for the Main Line of Public Works in 1826. A short-line railroad, the Philadelphia and Columbia, formed the first leg of the Public Works. From Columbia a system of canals along the Susquehanna River extended to Hollidaysburg where the canal boats were loaded on the Allegheny Portage Railroad, over the Allegheny Mountains to Johnstown, and then launched back into a canal for the last leg to Pittsburgh. The canal system consisted of sixty-four locks, sixteen aqueducts, sixty-four culverts and 152 bridges. The portage railroad opened in 1834 and consisted of a series of inclined planes, level railroads and the first railroad tunnel in America (Burgess 1949:10-11; Fitzsimons 1990:101; Klein & Hoogenboom 1973:137; Tripician 1959:2-3).

While the Main Line was an economic stimulus for much of the state, and drew worldwide attention as an engineering marvel, there were drawbacks. The repeated transfer between railroad and canal resulted in an expensive and slow journey of 3-1/2 days. Traffic on the route quickly out-paced the ability of the inclined planes to keep up. The inclined planes were prone to breakdown and expensive to maintain. Service was completely discontinued when the canal froze in the winter and often interrupted by spring floods or summer drought. These disadvantages made canals particularly vulnerable to competition by the expanding rail network in New York and Maryland.

In 1836, the Pennsylvania Legislature began commissioning surveys for a continuous line of railroad to tap the western markets. The impetus for constructing a through line was delayed by an economic depression in the early 1840s. In 1846 the Pennsylvania Legislature renewed its interest in the railroad issue, and the Pennsylvania Railroad Company (PRR) was incorporated and granted permission to build a line from Harrisburg to Pittsburgh (Burgess and Kennedy 1949:39).

John Edgar Thompson assumed the job of Chief Engineer in early 1847 and hired a group of experienced engineers to begin immediately laying out and building the road. Included in the group were Edward Miller, William B. Foster Jr., S. W. Mifflin, G. W. Leuffer, Strickland Kneass, Edward Tilghman and Oliver Barnes. Thompson began his railroad career in 1827 as a surveyor with the engineering corps for the Philadelphia and Columbia Railroad. From there he went to the Camden and Amboy Railroad Company where he served as Principal Assistant

Engineer. In 1832 he took the job of Chief Engineer and General Manager of the Georgia Railroad, where he remained until joining the Pennsylvania Railroad (Sipes 1875:11).

By the summer of 1847, Thompson had prepared the plans and contracts for the first twenty miles of railroad west of Harrisburg. By November, work was well underway along the banks of the Juniata River and another contract was let for a forty mile section to Lewiston. On 1 September 1849 the sixty-one mile section between Harrisburg and Lewiston, called the First Division, was opened and construction had begun on the PRR's first tunnel at Spruce Creek. (Shedd 1991:79; Sipes 1875:12).

The main labor force along the works of the railroad were Irish immigrants, most of whom had left behind the potato famine and political unrest in their homeland. The Irish workers were divided into two rival groups based on social differences established in Ireland, and riots and murders occurred on more than a few occasions. In one uprising the Sheriff of Huntingdon County mustered a posse of 300 men to put down the disturbance (Lytle 1876:149; Rung 1984:304). Another problem which caused great fear among the workers and managers of the PRR, and the residents along the route, were the outbreaks of Cholera in the work camps. In one instance at the camp at Alexandria seven men, all sharing the same shanty, were found dead of the disease (*Huntingdon Journal* July 17, 1849:2).

With the completion of the Spruce Creek Tunnel in September of 1850, the line was complete all the way to Hollidaysburg where it connected with the Allegheny Portage Railroad. Simultaneously, the railroad was being built from Pittsburgh working east, and by December 1852, the road was completed to Johnstown. The PRR's cars could run through from Philadelphia to Pittsburgh utilizing the inclined planes of the Portage Railroad to pass over the Allegheny Mountains (Sipes 1875:12). This final obstacle presented the greatest engineering challenge: to overcome the mountain without the use of inclined planes.

The PRR's solution called for a gradual ascent beginning in Harrisburg and culminating with the construction of the 3,600' long Allegheny Tunnel at Gallitzin. From Harrisburg, at an elevation of 310' above sea level, the railroad climbed at a grade not exceeding 21' per mile, to an elevation of 1,180' at Altoona. From Altoona the road steepens to a grade of 95' per mile until it reaches an elevation of 2,161' at the Allegheny Tunnel, the highest point on the entire line. Construction began on the tunnel in October 1851 (Sipes 1875:12).

Meanwhile, the Allegheny Portage Railroad had a plan for the construction of a "New" Allegheny Portage Railroad that would re-route their tracks around the mountain sides and through a new tunnel, also eliminating the need for the inclined planes. In 1852 the plan was approved by the Legislature and construction began (Baumgardner 1952:78- 79).

In February 1854, the PRR completed the Allegheny Tunnel to a degree that it could be opened to rail traffic. For the first time rail cars passed from Philadelphia to Pittsburgh without the use of inclined planes. The PRR, with its cross state routes fully operational, stopped running its cars over the Allegheny Portage Railroad lines. The loss was a severe blow to the financial well-being of the Public Works and shook the confidence of its supporters. Construction slowed and cost overruns further eroded public confidence until calls for the sale of the Main Line were being heard on the floor of the Legislature (Baumgardner 1952:81-82).

On 8 May 1855, as the timber work in the New Portage Tunnel was drawing to completion and the track was being laid, the Pennsylvania Legislature passed an act to sell the entire Main Line of the Public Works. Two months later on 1 July 1855, the tunnel was put into service, commencing the operation of the New Portage Railroad. The sale of the Main Line had not occurred as no bids had been submitted. The neighboring PRR line had been running trains for over a year through the new Allegheny Tunnel and, for all practical purposes, the "New" Allegheny Portage Railroad was obsolete.

In May 1857, the Legislature again passed an act for the sale of the Main Line and one month later the line was sold for 7.5 million dollars to the only bidder, the Pennsylvania Railroad. The PRR operated the Portage line for three months after its purchase before closing it for good; the operating and maintenance costs had exceeded the revenue. The line was torn up and the track shipped west for expansion of the PRR's line to Chicago (Baumgardner 1952:83).

The phenomenal success of the planning and construction of the PRR was attributed to John Edgar Thompson. Thompson was elected President of the PRR on 2 February 1852 after convincing the Board of Directors that he was better suited for the job than William Patterson, the sitting president. Thompson accused Patterson of dragging his feet on the expansion of the railroad. In the next twenty-two years until his death in 1874, Thompson's administration would make many important contributions to the development of the company. Thompson developed quality standards for track and equipment that became the standard of the industry. To create an exacting specification for the construction of track, a competition was instituted between the supervisors and foreman of the various divisions. Each division was to build a one mile sample of "perfect track" to be judged, the winning division receiving a cash prize. The best attributes from each of the samples were compiled into a set of track specifications that were then employed along the entire line. Each year track was measured and the division that maintained the most track to meet the exacting specifications received bonuses. This type of practical management led the PRR to be regarded as the finest built and managed railroad in the world (Sipes 1875:24).

Thompson also believed strongly in the application of new technology. He was the first to adopt iron in the construction of railroad bridges. As early as 1850 the PRR was building iron Pratt Truss bridges along their line between Pittsburgh and Altoona. Thompson continued to replace wooden bridges with iron and by 1875 there were 173 iron bridges between Philadelphia and Pittsburgh. The PRR was also the first to put rolled steel rails into use on a large scale, placing a large order with Cambria Iron Company of Johnstown, Pennsylvania in 1867. Yet another first was the development and use of back tanks for the rewatering of locomotives without stopping. The time saving invention consisted of a trough a quarter-mile long set between the rails. At a speed of up to forty-five miles per hour the locomotive could drop a scoop and draw in the water for the boiler (Alexander 1947:45-46; Condit 1960:112; Sipes 1875:24).

After completion of the continuous line, Thompson expanded the railroad's system westward from Pittsburgh, utilizing lines that either already existed or were projected in the direction of Cleveland, Indianapolis and Chicago; and eastward from Philadelphia to Jersey City and New York City. Competing railroads were brought under control by leases, stock control or bond guarantees, making the Pennsylvania Railroad the dominant railroad by 1868 (Baer 1988:8; Sipes 1875:12).

By 1870 the Northeast and Midwest bad become saturated with railroad lines. Fierce competition led to many consolidations, allowing weaker lines to survive and stronger lines to tap new territories. From 1860 to 1900 business on the Pennsylvania Railroad system doubled approximately every ten years. Branch lines were continually being built to serve coal, timber and industrial interests. In 1885 the PRR ranked as one of the most efficient railroads in the world. The PRR's total cost of operating expenses to move a ton of goods one mile was forty-one cents, less than one-half the cost in England, and the lowest of any railroad in the United States (Dorsey 1887:112; Tripician 1959:11).

A. J. Cassatt was elected President of the PRR in 1899 and essentially rebuilt the entire railroad with a series of improvements including the four-tracking of the lines through Pennsylvania and the addition of numerous freight lines. The four-tracking required the building of new tunnels at Spruce Creek and Gallitzin. In 1910 the Pennsylvania Railroad gained access to Manhattan and opened Pennsylvania Station. Just before the Great Depression, 30th Street Station was built in Pbiladelphia (Tripician 1959:13,21).

After World War II, the Pennsylvania Railroad began a billion dollar improvement program. Track, yards and sidings were improved, new bridges, culverts and trestles built, tunnels eliminated, signal facilities expanded, and stations and buildings modernized. More than 1,400 diesel locomotives and 30,000 freight cars were added to the system. Despite the improvement program, the Pennsylvania Railroad began to decline, a reflection of the decline of their principle customers, the heavy manufacturing industries and competition from air and highway transportation (Mileposts on the Pennsy n.d.:7).

In 1962, stockholders of tbe two major northeastern rail systems, the Pennsylvania and the New York Central, approved a merger plan wbich resulted in the formation of the Penn Central. The merger failed and the Penn Central declared bankruptcy in 1970. Conrail, purchased the viable portions of the Penn Central and six other railroads in 1976 (Baer 1988:n.p.; Saylor 1964:129).

History of Allegheny Tunnel

Construction on the Allegheny Tunnel began October 14, 1851. The excavation was completed 21 January 1854, and the arcbing completed in February of 1855. Engineers of the project, all employees on the PRR were as follows: Edward Miller and Herman Haupt, Cbief Engineers; Thomas Reilly, Engineer; Thomas Seabrook, Principal Assistant Engineer. John Rutter and Son built the tunnel and were known as one of the oldest and most respected railroad contractors of the day. After the death of John Rutter in 1853, his son Thomas completed the contract (Drinker 1878:301, 330, 333, 535).

The construction of the tunnel encountered many difficulties, including fourteen different strata, some very unstable, and bigh volumes of water. Three sbafts were sunk, 150', 212' and 205' in depth, to allow tunneling to progress on eight headings. The shafts were 8' by 12' and lined with 12" hemlock timbers. Water was a problem in all the shafts and initially attempts were made to keep it under control by bailing. Rock buckets called bowks, which hauled the excavated material out of the shafts, were alternately filled with water, holding roughly eighty gallons. Later, to free the buckets from water detail and speed the mucking along, sixteen horsepower steam engine pumps were installed at all the shafts. The flooding of the middle shaft, however, was so severe that it had to be abandoned until a fifty horsepower plunger pump was installed to keep up with the 175 gallon-per-minute intrusion rate (Drinker 1878:325; Pennsylvania Railroad Annual Report (PRRAR) 1852:15; Stauffer 1906:301).

The headings were driven from the top, 8' high and 20' wide. The leading edge of the tunneling, called the breast, was worked with four hammers, meaning eight men. One man, called a shaker, held the iron drill bit known as a jumper, which be turned slightly with each blow of the hammer wbile the other man swung the sledge hammer. After a pattern of spaced boles were drilled about 4' deep across the breast, the holes were packed with black powder, and detonated. A total of 6,450 kegs of black powder was used, detonated with 4008' of Bickford's fuse. The removal of the blasted rock was called mucking. The rock was loaded in small horse draw cars and hauled out the ends or loaded into buckets and hauled up the shafts (Drinker 1878:330; Sandstrom 1963:412).

As the beadings advanced, timbering was placed and a second crew of miners followed removing the bench, also called the bottom. The bench was the section of rock from the bottom of the heading, usually the same point as the springline of the arch, down to the final grade of the tunnel. In this case the bencb was roughly 16' thick and 20' wide. The benches were often drilled from the top as well as the face to free as mucb rock as possible and often two hammers were employed on a single drill, known as "double-jacking," to speed the process. Chunks of rock too large to be hauled away by the muckers were split or blasted while other work proceeded. The object of the foremen was to find ways to employ as many men as possible, as the limiting factor was the available room for men to work (Drinker 1878:218).

In the fall of 1852, a year into the tuned work, it was becoming apparent that the tunneling was "treacherous in character" and that the difficulties encountered were "perhaps greater than have attended the progress of any similar work in this country" (PRRAR 1854:28,29). A fourth shaft was sunk to make up for lost time due to the difficult conditions and more men were added to the workforce. A bonus was offered to the workers by the PRR for completing the tunnel on time and the contractor added a nigbt shift to help towards that goal (PRRAR 1854:28).

The unstable nature of the rock caused numerous cave-ins or "falls", which, by the estimation of Herman Haupt, required the removal of twice the quantity of material "as would have been necessary had the rock been of a solid and permanent character" (PRRAR 1854:28). Rock types included several varieties of sandstones, limestones and fire-clays, as well as beds of slate and coal. The bedding planes were almost horizonal, dipping sligbtly toward the west. A 4'-6" thick seam of bituminous coal was encountered in almost the exact middle of the tunnel, 1800' in from the east portal. The roof required immediate timbering as the headings progressed and all but 900' of the tunnel was timbered before the bottom was removed. Rutter used a timbering method known as the English bar system and it was the first known use of the technique in America (Drinker 1875:325). The setting of the timbers varied depending on the downward pressure exerted by the overlying rock which in turn varied with the type of rock encountered. Areas of light loading were timbered as shown in Figure 1, and areas of heavier loading were timbered as shown in Figure 2. At the center of the tunnel a 50' section of broken rock required extra heavy timbering using timber 16" in diameter as shown in Figure 3 (Drinker 1878:327,328,329).

All of the timbering was built in, which means that the arch was built below the timbering and brought up tight against it with masonry infill such as scrap brick or stone. The English system proper requires the removal of all the timbering as the masonry arch proceeds, with the space between the arch and the roof being filled with solid masonry. The "drawing of the bars" as the technique was known, was considered by most tunnel engineers at the time to be the superior method. However, none of Rutter's tunnels where the timbering was built in have failed as a result of it (Drinker 1878:301).

Throughout that same autumn, stone was hauled in from a quarry two miles away and cut for the portals and abutments. Experiments with the clay in the immediate area around the tunnel found that good quality bricks could be made from it, and by the spring of 1853 bricks were being manufactured on a large scale. Approximately five million bricks were required for the arch lining (Drinker 1878:326; PRRAR 1853:34).

In February 1853, on the day the headings were completed and the tunnel holed-through, John Rutter died. The contract was completed by his son Thomas. The tunnel was put into service immediately upon completion in 1854 and the brick arching finished while the trains were running.

At the beginning of the job laborers were paid $1 per eleven hour day and miners were paid $1.25 per eight hour day. Three strikes for higher wages occurred over the duration of the job, of one, three, and six weeks' duration. By 1853, laborers' wages had increased to $1.25 per day and miners were making $1.50 per day (Drinker 1878:326).

A total of 88,600 cubic yards of material was excavated at a cost of $3.47 per cubic yard, for a total cost of $307,442. The cost breakdown per cubic yard of the labor, materials and equipment used on the project, according to Drinker (1878:330) was as follows:

Labor	$2.50
Steel and Iron	.08
Powder and Fuse	.22
Candles	.08
Engines, Ropes and Chains	.11
Kettles	.02
Cars and Trucks	.09
Timber	.08
Pumps	.06
Horses and Carts	.10
Buildings and Sundries	.13
Total per cubic yard	$3.47

With the construction of the new westbound Gallitzin Tunnel adjacent to the Allegheny Tunnel in 1904, one track was removed and the remaining track realigned to the center to provide addition clearance.

By 1928, deterioration of the tunnel had reached a point that the need for repairs was evident. The Fritz-Rumer-Cooke Company, a tunnel contractor, was invited to make an inspection of the tunnel and present its repair recommendations. The problem of loose and falling bricks and stones of the arch and benchwalls were primarily due to failure of the mortar joints from the action of water, frost and locomotive blast. The worst problems were at the ends of the tunnel for a distance of about 450' in from the portals. The contractor recommended that the inner ring of brick be removed in these areas and a 3" layer of reinforced Gunite be applied (Bryan 1928). Nothing was immediately done and in 1932 an inspection by PRR Bridge Inspector L. E. Morrison found the condition of the mortar joints worsening. Morrison felt that rapid collapse of the inner ring was imminent and recommended that repairs be done within the year (Morrison 1932). Wholesale collapse of the lining never occurred even though inspectors urged every few years that repairs be made immediately (Flinn 1938a, 1938b, 1939; Leonard 1938; Morrison 1941). It was not until 1951 that shotcrete repairs were finally initiated beginning at the east end of the tunnel. Three hundred linear feet (l.f.) of shotcrete were placed in 1951, 275 l.f. in 1952 and 500 l.f. in 1953 (Inspection Report 1953). No record exists as to when the remaining portions of the tunnel were shotcreted or if any subsequent repairs have been made.

In 1941, a need arose to detour freight trains through the Allegheny Tunnel so that Gallitzin Tunnel could be closed for repair work (Leonard 1941). Due to the steep grade on the approach from the east, freight trains could not reach a speed sufficient to stay ahead of the smoke accumulation in the tunnel. Train engineers were sometimes overcome by the gases, losing consciousness on the trip through the tunnel. The Gallitzin Tunnel was equipped with a steam powered blower in 1905 after two track men were run down and killed in thick smoke. The Gallitzin system consisted of an immense 200 horsepower steam driven fan with a 50' long sheet iron nozzle attached to the east end of the tunnel. The fan was started when a train entered the tunnel and pushed 502,000 cubic feet of air into the tunnel per minute (c.f.m), propelling the smoke ahead of the train and providing the operators with fresh air (*Engineering News* 1899:65; *Railway Age* 1907:643; *Railway Gazette* 1906:246; Swenk 1941). The 1941 plan called for four new electric motor driven fans, two for each tunnel, each capable of 320,000 c.f.m. The fans were housed in masonry buildings with glass block windows. The system went into operation in 1945, was present in 1963 as evidenced by photographs, but has since been dismantled (Somerville 1946).

The Engineers of the Allegheny Tunnel

Herman Haupt (1817-1905) is noted for his diverse accomplishments in railroad, bridge and tunnel engineering as well as distinguished service as Brigadier General in the Civil War. Haupt attended the U. S. Military Academy in 1835 but resigned shortly after graduation to work as an engineer with the Norristown and Valley Railroad. Between 1836 and 1839 he worked as an Assistant Engineer of the Pennsylvania State service, locating the railroad from Gettysburg to Potomac. Haupt taught civil engineering and architecture at Penn College in Gettysburg from 1842 to 1847, when he joined the Pennsylvania Railroad as Principal Assistant to the Chief Engineer, John Edgar Thompson. In recognition of his work with the Allegheny Tunnel, Haupt was made Chief Engineer of the PRR in 1853 (ASCE 1972:56-57). As with many PRR officials, Haupt had numerous business ventures on the side, including real estate speculation and development along the PRR lines. These ventures, as well a generous salary from PRR, made Haupt very wealthy. Upon completion of the Allegheny Tunnel, Haupt felt qualified to tackle the construction of the Hoosic Railroad Tunnel in Massachusetts. He resigned from the PRR in 1856 to devote his time to arranging financing for the project, much of which he secured with his own money (Ward 1973:52-53). From 1858 to 1861 Haupt worked on the tunnel using the first pneumatic tunnel drilling machine in America invented by Haupt and others (ASCE 1972:57; Drinker 1878:233). Financing problems and disagreements with the state engineer led Haupt to leave the Hoosic Tunnel project unfinished. In 1862 he was named Brigadier General of the U.S. Volunteers in charge of construction and transportation on the Union military railroads. Haupt built several important bridges during the war including a 750' bridge over the Chattahoochie River which he completed in under five days (ASCE 1972:57; Boatner 1959:386). After the war Haupt continued to develop tunneling machines and wrote numerous books on the subject as well as on bridge design. In the last quarter of the nineteenth century he was affiliated with several railroads, was instrumental in integrating railroads and steamship transportation, developed and built a crude oil pipeline across Pennsylvania, and developed air powered motors for a variety of machinery (ASCE 1972:58).

Edward Miller (?-1872) began his long career in railroad engineering with the Allegheny Portage Railroad in 1830. He served as Chief Engineer for the following railroads: the Catawissa Railroad and the Morris and Essex Canal in 1836, the Sunbury and Erie Railroad in 1839, the New York and Erie in 1840, the Schuylkill Navigation Company in 1845, the Pennsylvania Railroad in 1850, the North Pennsylvania Railroad in 1852, and the Pacific Railroad of Missouri in 1856. Miller also has a railroad contracting firm which built the Philadelphia and Erie line and the Warren and Franklin line. Miller served as President of the Harrisburg and Lancaster Railroad Company in 1843 and the North Pennsylvania Railroad in 1852 (*Railroad Gazette* 1872:78). It should be noted that it was very common in the railroad business in the nineteenth century to occupy several positions simultaneously with different companies. Engineers moved about frequently, often working with a company only for the duration of a particular construction project.

Thomas Seabrook (1817-1897) began his career with the PRR as an engineer locating the Western Division of PRR's main line in Pennsylvania. In 1857 he was appointed Resident Engineer in charge of the line between Harrisburg and Pittsburgh. In 1859 Seabrook was made Chief Engineer of the lines west of Pittsburgh (Railroad Gazette 1897:176).

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APPENDIX: Figures

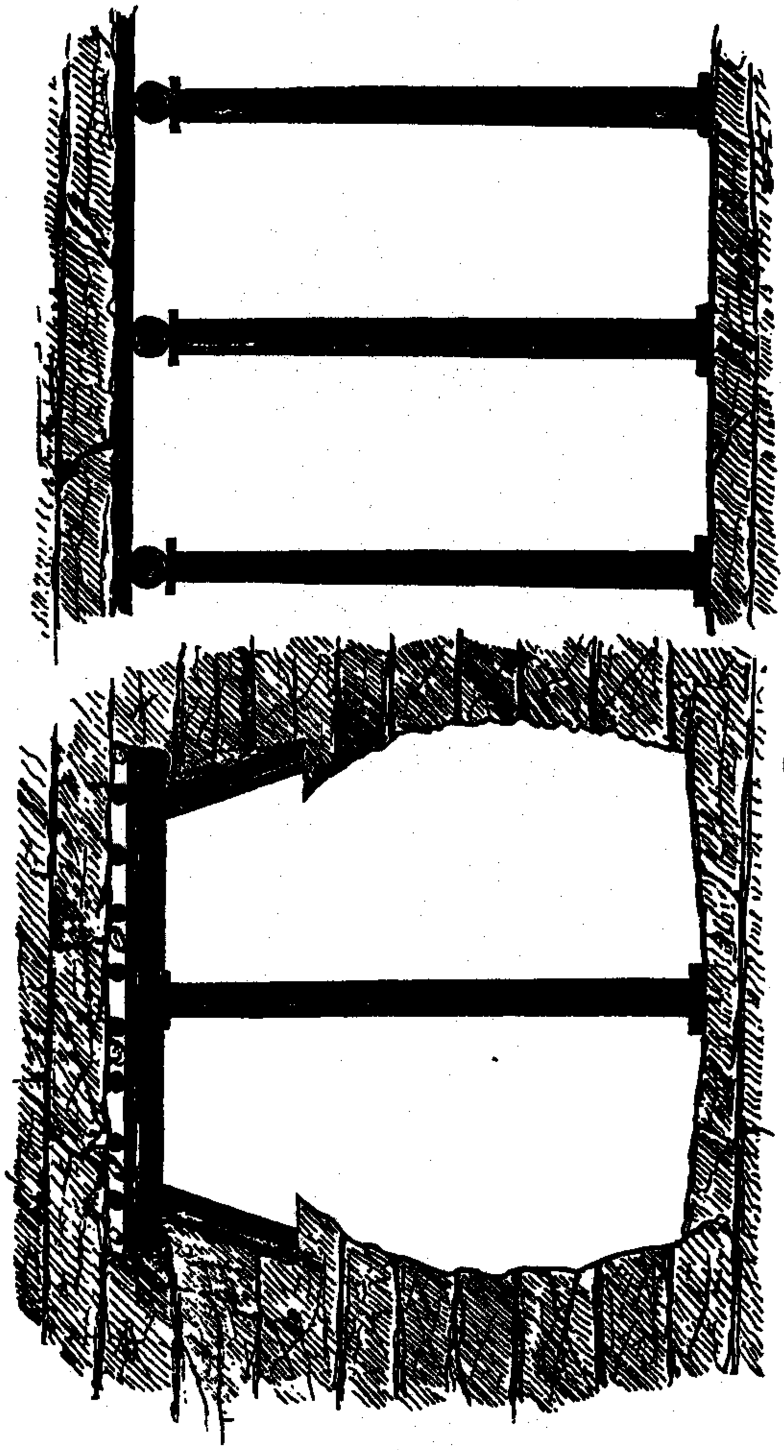

FIG. 156.
ALLEGHENY TUNNEL, PENNSYLVANIA RAILROAD.
Scale, 10' = 1".

Figure 1 Timbering Methods, Allegheny Tunnel (Drinker 1878:327).

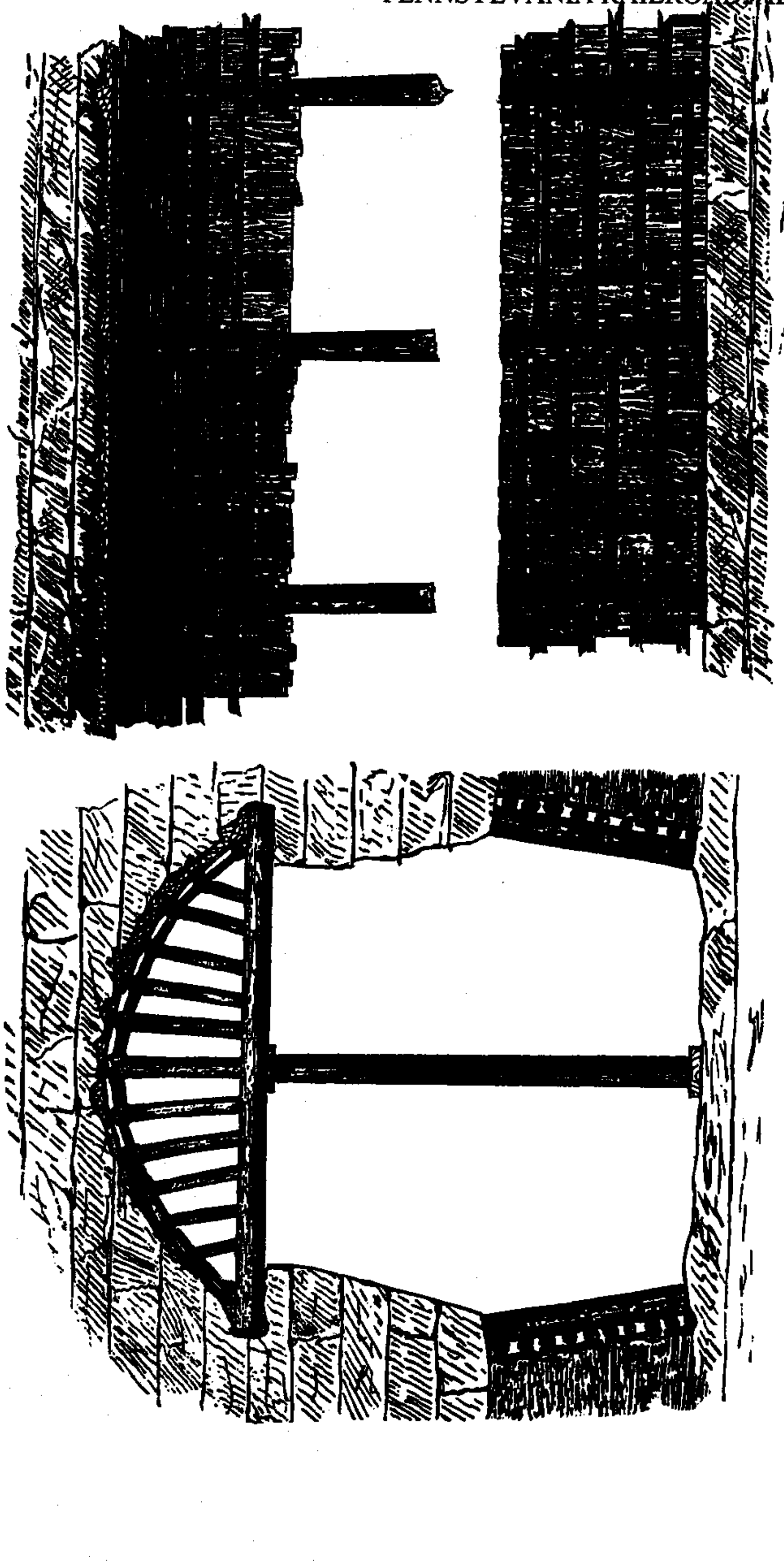

FIG. 187.
ALLEGHENY TUNNEL, PENNSYLVANIA RAILROAD.
Scale, 10′ = 1′.

Figure 2 Timbering Methods, Allegheny Tunnel (Drinker 1878:328).

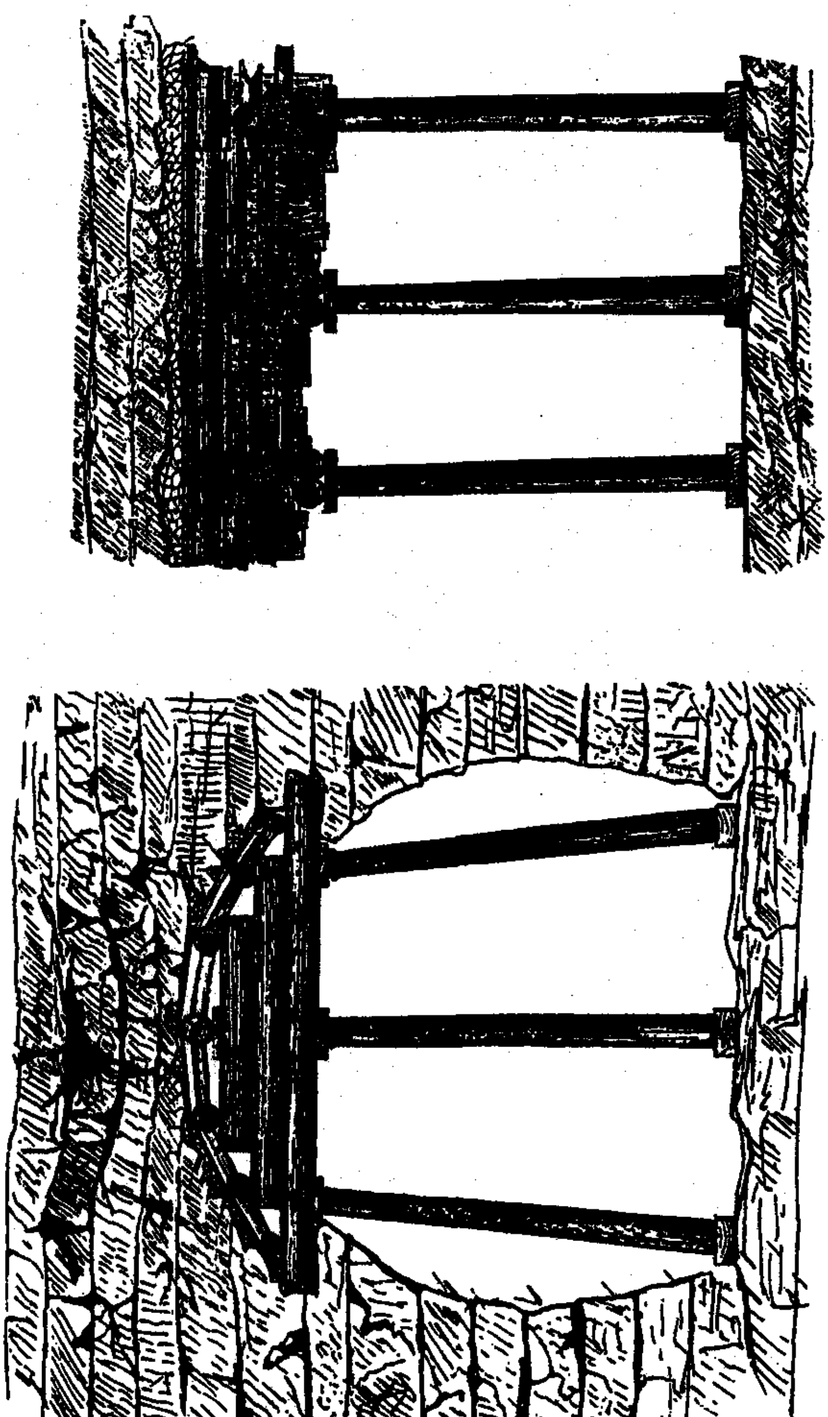

FIG. 168.

ALLEGHENY TUNNEL, PENNSYLVANIA RAILROAD.

Scale, 10' = 1'.

Figure 3 Timbering Methods, Allegheny Tunnel (Drinker 1878:329).